VEGETATION ASSESSMENT SURVEYS
near the
MINISTRY OF TRANSPORTATION'S
LONGBOW LAKE PATROL YARD
1988-89

DECEMBER, 1989

MOE
LON
VEG
APFA

c.1
a aa

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca

VEGETATION ASSESSMENT SURVEYS
near the
MINISTRY OF TRANSPORTATION'S
LONGBOW LAKE PATROL YARD,
1988-89.

D. J. Racette
Environmental Scientist

H. D. Griffin
Chief, Air Quality Assessment

TECHNICAL SUPPORT SECTION
NORTHWESTERN REGION
ONTARIO MINISTRY OF THE ENVIRONMENT

December, 1989

MOE
LON
VEG
APFA

INTRODUCTION

In September, 1988, the Ontario Ministry of the Environment, Northwestern Region, conducted an injury assessment survey of vegetation near the Ministry of Transportation (MTO) Longbow Lake patrol yard, 19 kilometres east of Kenora, Ontario. The patrol yard, built in 1975, stores sand and salt (sodium chloride) for winter road maintenance. Results from the 1988 survey were reported in a previous memorandum.[1]

The Ministry's investigation was in response to complaints from a Barnes Lake resident living approximately 200 m (metres) east of the patrol yard. The complainant alleged that the MTO facility was the source of contaminants which caused injury to trees and contaminated the drinking water supply.

This memorandum reports the results of field assessments and laboratory analysis of soil and vegetation samples obtained in September, 1988 and August, 1989.

METHODS

Samples of tree foliage, twigs and two depths of soil (0-5 and 10-15 centimetres) were collected in September, 1988, from five sites around the patrol yard and from a control site remote from the affected area (see Figure 1). In August, 1989, only tree foliage from sites 1, 4 and the control was sampled. Standard Ministry sampling and sample processing procedures were followed.[2] All samples were analyzed for sodium and chloride at the Ministry's Toronto laboratory.

RESULTS

Samples of injured trembling aspen and balsam poplar foliage were collected on August 25, 1988, for pathological examination. These specimens had minor secondary diseases and insect pests but the main causal agent of the injury could not be determined.

On September 8, 1988, injury to tree foliage was observed behind the MTO sand dome, along the north and south side of the access road to the complainant's residence, and in a larger area near a sand and gravel storage area north of the MTO office and garage building (see Figure 1). Injury in the storage area also extended east across Highway 17 towards Barnes Lake. In the area behind the sand dome and along a drainage channel near the complainant's residence, there was severe marginal necrosis (death) of leaves of trembling aspen, balsam poplar and speckled alder. There was also severe terminal necrosis of 1-year-old black spruce needles, severe marginal chlorosis (yellowing) of serviceberry leaves, and severe interveinal chlorosis on white birch foliage. In the sand and gravel storage area about 60 m north of the patrol yard, jack pine, spruce, balsam fir and poplar trees were killed outright. Loss of bark from these trees indicated that they died several years ago. There was also severe marginal necrosis of trembling aspen foliage and death of ground vegetation (mainly grasses) along an obvious drainage path in this area.

Re-evaluation of the vegetation injury zone on August 10, 1989, showed that the area and severity of visible injury to vegetation foliage was much less in 1989 than in September, 1988 (see Figure 2).

The chemical analysis results for the vegetation is presented in Table 1. In 1988, foliar sodium levels were slightly to moderately higher in vegetation in the injury zone than in control samples. Chloride concentrations were significantly elevated and exceeded control values by up to 1000 times. Most sodium and chloride levels were lower in 1989 than in 1988.

Studies in southern Ontario and in Minnesota have shown that chloride levels of 1000-2000 $\mu g/g$ in conifer foliage are associated with foliage injury of 10 percent.[3] Levels of 7000 $\mu g/g$ may cause injury of 80 percent. In broadleaved trees, foliar injury may occur

with chloride concentrations ranging from 2500 to 5000 $\mu g/g$.[4] Foliar chloride in the Longbow Lake patrol yard area was much higher than these reported threshold levels.

In 1988, levels of sodium and chloride in twigs showed a similar pattern to that found in foliage.

Table 2 reports levels of sodium and chloride in soil collected in 1988. Levels of sodium in surface soils were 4 to 6 times higher than those at the control site. Chloride concentrations were 50 to 80 times higher than controls. Levels of these two contaminants tended to be higher in surface than in subsurface soil.

DISCUSSION

Information received from MTO staff revealed that operations at the MTO patrol yard probably contaminated the surrounding soil and groundwater with road salt. The area behind the sand dome was likely contaminated when sanding trucks were loaded in the winter. During snow removal in the patrol yard, contaminated snow was pushed behind the sand dome into a marsh. During spring runoff, contaminated water from the marsh and surface water from the yard crossed Highway 17 through a culvert south of the access road to the complainant's residence. This drainage channel runs about 60 m along the south side of the access road before crossing to the north side through another culvert. About 60 m farther downstream, the channel enters Barnes Lake, a source of drinking water for two year-round residences and one seasonal cottage owner.

Since 1975, treated sand, that could not be accommodated in the sand dome, was stored at least once in the gravel pit north of the patrol yard. The treated sand, containing 4-5 percent salt, stood uncovered for later use. The drainage pattern from this area is toward Barnes Lake, crossing Highway 17 through a culvert about 60 m north of the patrol yard access road.

In the spring of 1989, MTO hired a consulting firm to determine the best methods to control off-site loss of salt from winter truck washing and spillage during handling and delivery of salt.

During the winter of 1988-89, before the consultant's report was received, MTO took interim action. No treated sand was stored outdoors and spilled salt was recovered. However, truck wash water was not recovered and contaminated snow was piled on the hill on the north side of the patrol yard. Salt from both these sources eventually drained into Barnes Lake. These changes in salt management probably account for the decreased vegetation injury and lower foliar salt levels in foliage found in 1989 compared with 1988.

To further curtail salt losses in 1989, three of the consultant's proposals were implemented; all cracks in the floor of the sand dome were sealed, barriers to capture surface run-off water near the sand dome were constructed (see Figure 2), and storage tanks were installed to collect water from the sand dome area and wash water from trucks. Guywires were also placed between the salt sheds and sand dome and between the sand dome and the barrier wall to prevent disposal of contaminated snow in these areas. Contaminated snow near the salt sheds and sand dome areas and liquid from the two tanks will be disposed of at an approved site, about 10 km south on Highway 71.

In 1990, provided sufficient funds are available, replacement of the sand dome and salt sheds will be considered. The consultant recommended that a larger structure be built to both house and handle sand and salt under one roof, thereby eliminating salt losses from handling operations outdoors.

CONCLUSIONS

1. Road salt from the MTO Longbow Lake Patrol Yard contaminated groundwater, soil and vegetation in the surrounding area. Damage to vegetation was severe and extensive (1.8 hectares) in 1988. The injury zone was much smaller in 1989 (0.2 hectares) and some of the trees showed signs of recovery.

2. Damage to vegetation in the injury zone was caused by phototoxic accumulations of chloride in plant foliage.

3. The interim salt management program implemented by MTO in late 1988 appeared to produce benefits in 1989.

RECOMMENDATIONS

1. MTO should continue to pursue a diligent salt management program at Longbow Lake to minimize salt losses.

2. MTO should review salt handling procedures at all patrol yards in Ontario to ensure safe handling and storage of all de-icing agents and should conform to guidelines referenced in "Guidelines for Snow Disposal and De-icing Operations in Ontario".[5]

REFERENCES

1. Ontario Ministry of the Environment. 1988. Memorandum from D. Racette to D. McMehen, November 7, 1988.

2. Ontario Ministry of the Environment. 1983. Field investigation procedures manual. Phytotoxicology Section, Air Resources Branch.

3. Sucoff, E., Ray Feller and Dennis Kanteen. 1975. De-icing salt (sodium chloride) damage to Pinus resinosa Ait. Can. J. For. Res. 5:546.

4. Hofstra, G. and G. P. Lumis. 1975. Levels of de-icing salt producing injury on apple trees. Canadian Journal of Plant Sciences 55:113. 1975.

5. Ontario Ministry of the Environment. 1975. Guidelines for Snow disposal and de-icing operations in Ontario.

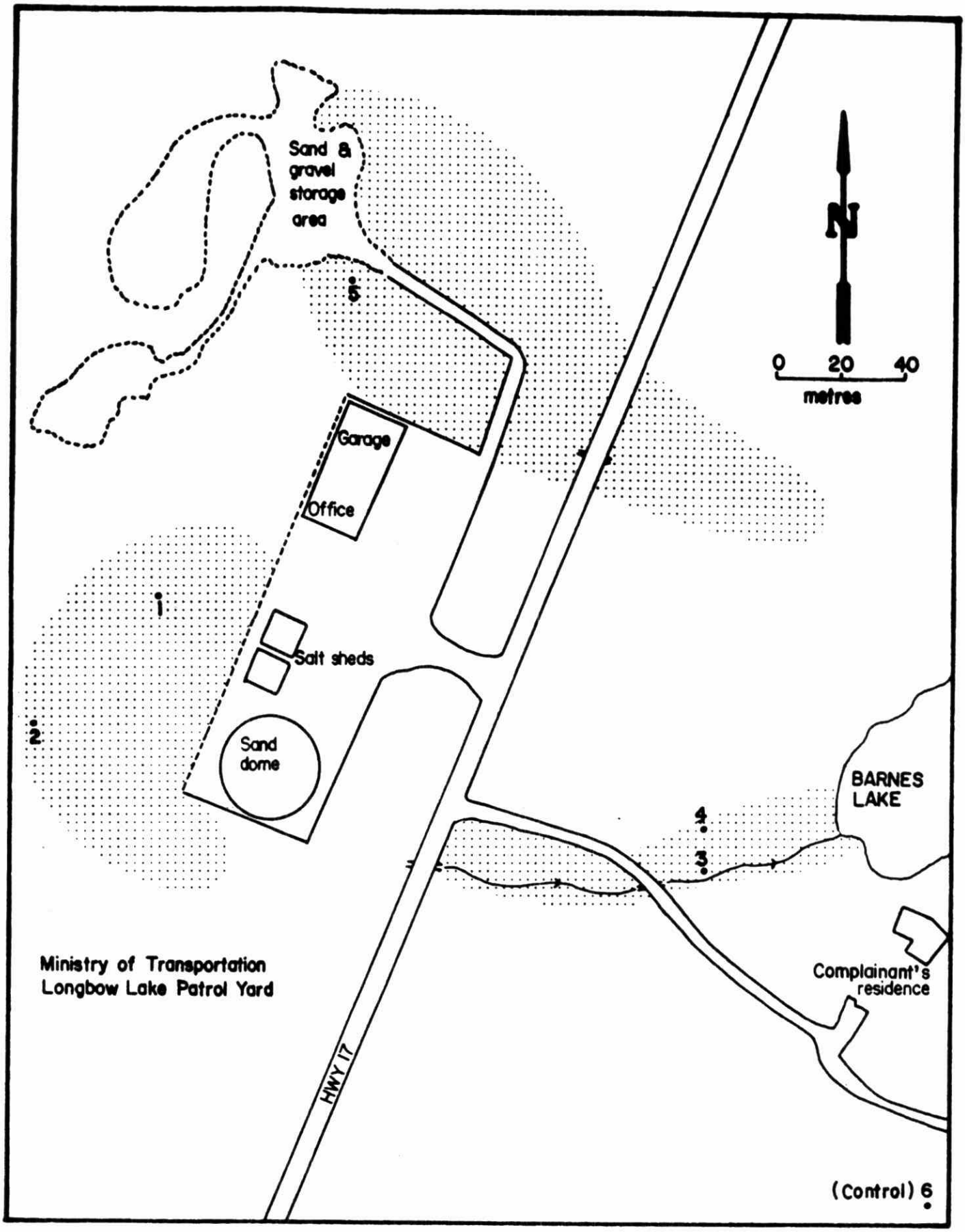

Figure 1. Sampling sites and vegetation injury zone, Ministry of Transportation (Longbow Lake Patrol Yard), September 8, 1988.

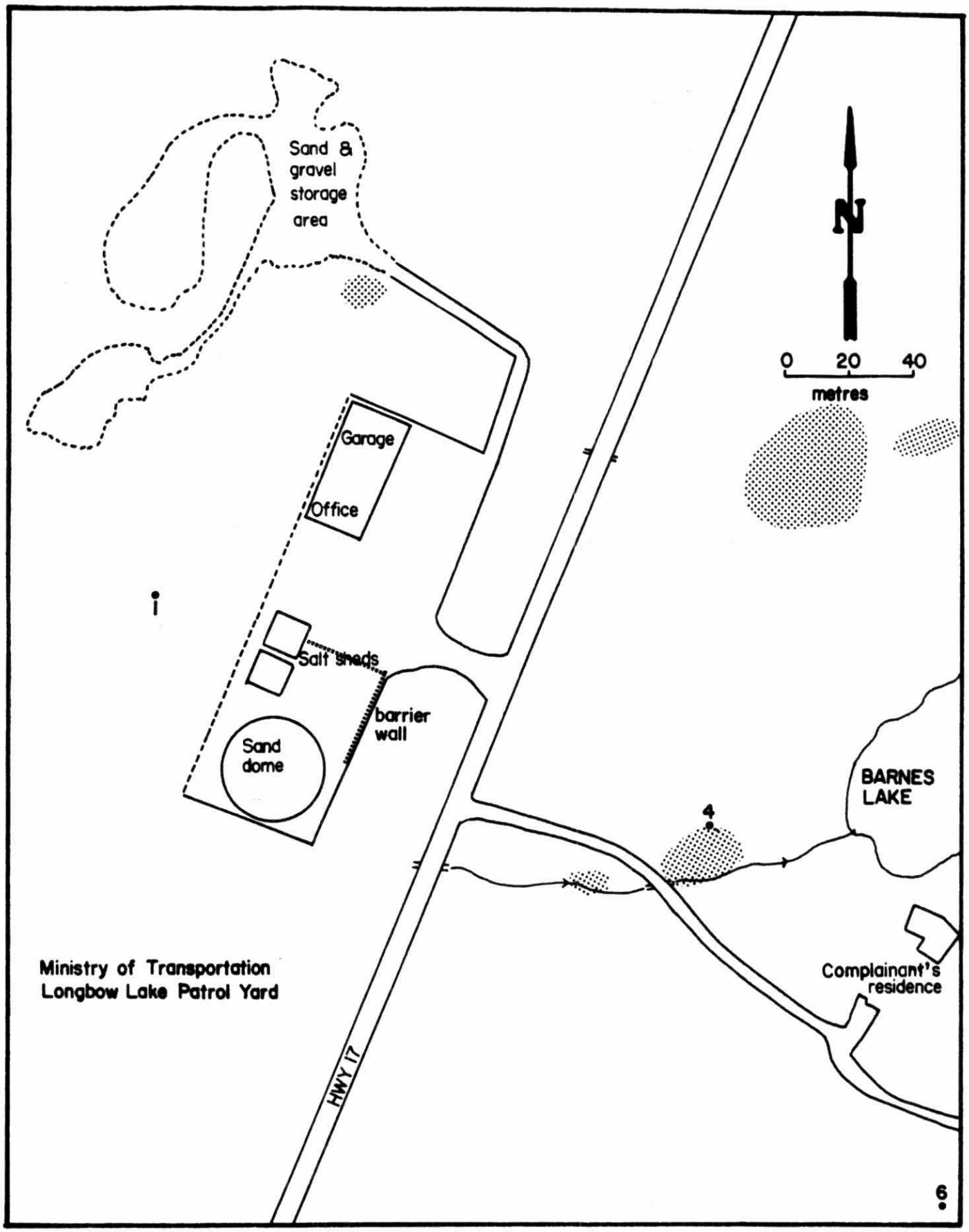

Figure 2. Sampling sites and vegetation injury zone, Ministry of Transportation (Longbow Lake Patrol Yard), August 10, 1989.

TABLE 1. Levels of sodium and chloride ($\mu g/g$, dry weight) in vegetation foliage and twigs near the Ministry of Transportation's Longbow Lake Patrol Yard, September 8, 1988 and August 10, 1989.

	Trembling Aspen					
	Foliage				Twigs	
	Na[a]		Cl[b]		Na	Cl
Site	1988	1989	1988	1989	1988	1988
1	10	10	8300	10000	9	1500
3	34	–	7200	–	78	1000
4	35	32	13000	9900	61	900
5	15	–	5400	–	47	[c]
Control	13	5	1900	2000	10	<20

	Black Spruce (1988)							
	Current Year						One-year-old	
	Needles		Twigs		Needles		Twigs	
Site	Na	Cl	Na	Cl	Na	Cl	Na	Cl
2	9	13000	19	9100	10	11000	28	7000
Control	9	200	12	200	7	100	17	80

	White Birch				Specked alder		Serviceberry			
Site	Na		Cl		Na	Cl	Na		Cl	
	1988	1989	1988	1989	1988	1988	1988	1989	1988	1989
3	–	–	–	–	20	12000	86	–	3700	–
4	20	19	22000	11000	–	–	54	36	1800	260
Control	9	9	<20	<20	14	1600	19	10	<20	<20

[a] Na = Sodium
[b] Cl = Chloride
[c] Insufficient sample
–No sample collected

TABLE 2. Levels of sodium and extractable chloride (μg/g, dry weight) in two depths of soil near the Ministry of Transportation's Longbow Lake Patrol Yard, September 8, 1988.

	Soil (0-5 cm)		Soil (10-15 cm)	
Site	Na	Cl	Na	Cl
1	660	1200	290	1100
3	680	780	710	800
4	370	1100	380	760
Control	91	15	100	14

DISTRIBUTION LIST

TECHNICAL MEMORANDUM: "Vegetation assessment surveys near the Ministry of Transportation's Longbow Lake Patrol Yard, 1988-89".

Mrs. M. C. C. Brown

Mr. W. Toner

Mr. J. Port

Ministry of Transportation: Director, Northwestern Region
District Engineer, Kenora
Environmental Planner, Thunder Bay

Northwestern District Health Unit: Medical Officer of Health, Kenora

Media: CBQ Radio: New Department
Daily Miner and News: Editor
The Holidayer: Editor
CJRL Radio, Kenora: News Department
CJBN TV, Kenora: News Department
Chronicle-Journal/Times News: Editor

Ministry of Northern Development and Mines: Northern Development Officer

Ministry of the Environment -
Northwestern Region: Director
Manager, Technical Support
Manager, Abatement
District Officer, Kenora
Trace Contaminants, Supervisor, Regional Laboratory
Chief, Water Resources Assessment

Northeastern Region: Chief, Air Quality Assessment

Air Resources Branch: Manager, Phytotoxicology Section

Environmental Approvals and Land Use Planning Branch: Supervisor, Approvals Engineering

Communications Branch: Project Coordinator, Client Services

(15946)
MOE/LON/VEG/APFA

	DATE DUE		

MOE/LON/VEG/APFA
Racette, D.J.
Vegetation
assessment surveys apfa
c.1 a aa

Environment Ontario
Laboratory Library
125 Resources Rd.
Etobicoke, Ontario M9P 3V6
Canada